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14. ABSTRACT

The Northern Hunters, a combined team of academia and industry attempted to design and build a fleet of autonomous unmanned ground vehicles (UGVs) that would map out an unknown area and search for objects of interest. The intent was to have human ?surveillance? over the fleet, but not control any of the UGVs directly, unless there was a malfunction. Our design called for a fleet of 10 UGVs, working in squads of 3 units, to search through the unknown area and to find the simulated objects, both static and mobile. As our team was eliminated from the competition in early June, our worked stopped, and has not proceeded any further.

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Final Report for AOARD 104023 "MAGIC 2010 Competition - The Kingston Team"
Dated 27 Oct 09

Date: 16 Dec. 2010

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Abstract: The Northern Hunters, a combined team of academia and industry attempted to design and build a fleet of autonomous unmanned ground vehicles (UGVs) that would map out an unknown area and search for objects of interest. The intent was to have human "surveillance" over the fleet, but not control any of the UGVs directly, unless there was a malfunction. Our design called for a fleet of 10 UGVs, working in squads of 3 units, to search through the unknown area and to find the simulated objects, both static and mobile. As our team was eliminated from the competition in early June, our worked stopped, and has not proceeded any further.

Introduction: In accordance with the MAGIC 2010 competition regulations, the Northern Hunters team attempted to build and program the fleet of 10 UGVs using low-cost, commercially available components. Rather than coding the behavior of each UGV separately, a Top-Down design approach was taken using a Model Driven Development (MDD) approach that employed leading edge software design tools (Rational RoseRT). In simulation, the behavior architecture of the UGV squads (and fleet) worked well. Hardware for 4 UGVs was assembled and partially tested; however, the integration of the hardware with our software models never came to fruition. We were not able to port to the software models (at any level) into any of the hardware we had assembled. When the MAGIC 2010 judging team came on June 2010, our 4 robots were not completely assembled and there was no behavior functionality ready to be shown on the UGVs. Functionality of various sub-systems was complete and demonstrated, but was enough to allow us to continue in the competition.

The entire MDD approach has been shelved until a new, more MDD reliable tool is found and we have more experience in interfacing the models to specific hardware technologies.

Experiment: Experimentation was limited to component and sub-system testing as each was completed. Blob identification and tracking (with HD cameras), localization (2m accuracy) and local mapping were the only hardware modules that were completed. Tests were completed with the vehicles on blocks and only ever one UGV at a time. Tele-operations and camera feed (lo-Res) to our ground station were the only functionalities that worked at a fleet-wide level.

Software behavior was simulated over various sized "fleets" of desktop PCs but was never trialed on UGV hardware (PC-104 stacks).

Results and Discussion: Of the 10 UGV platforms desired, only 4 were ever built. All 4 UGVs had functioning teleop commanding capabilities, Hi-Res video ID and tracking capability and wireless Lo-Res video camera feeds. After elimination from the competition, no other vehicles were built. Attempts at porting the behavior models were made to other commercially available UGV platforms with little success.

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